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PREDICTING TRANS-LAMINAR FRACTURE USING VCCT AND IN-SITU CT SCANS

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With the upsurge in use of advanced composites in the aerospace, marine and automotive industries, a comprehensive understanding of their failure mechanisms, especially trans-laminar fracture is important. Previous work on this topic was reviewed in Ref. [1]. More recently, a High-fidelity Finite Element Method (Hi-FEM) has been developed to deduce the R-curve for Mode I trans-laminar fracture based on the previous work [2-5]. The measurement of crack increments Δa in trans-laminar fracture tests has proven challenging. There are numerous methods such as optical measurement, Digital Image Correlation (DIC) and deplying, with X-ray Computed Tomography (CT) being an especially powerful tool to examine internal damage states and measure crack growth [4]. However, multiple interrupted tests are required for crack length measurements and dye penetrant is often needed to enhance the CT scan images which may induce a negative effect on test results.

The current research aims to develop an in-situ CT scanning method to characterise Mode I trans-laminar fracture properties such as R-curves in a single continuous test. The R-curve measured using in-situ CT scans is applied with the Virtual Crack Closure Technique (VCCT) for the failure prediction of another notch configuration. A test panel was manufactured at JAXA through Vacuum assisted Resin Transfer Moulding (VaRTM). The material used was biaxial carbon Non-Crimp Fabric (NCF) with a stacking sequence of $[(45/-45)/(0/90)]_{2s}$. The geometry is in accordance with the ASTM E1922 standard. The in-situ CT scans are conducted in JAXA. A customized in-situ test rig has been developed as shown in Figure 1.



Figure 1. In-situ CT scanner in JAXA.

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